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GENETIC DIFFERENCES IN JUVENILE SHUMARD OAK

This is a report on the genetic differences observed among seedlings of four seed collections of Shumard oak (Quercus shumardii var. shumardii) during the first 2 years of growth. It is based on data from replicated seedbed and nursery plots at the Michaux Quercetum.

(The Michaux Quercetum is a cooperative project of the Northeastern Forest Experiment Station and the University of Pennsylvania's Morris Arboretum, at Philadelphia, Pa. The project was started in 1953 to provide an authenticated collection of native and exotic oak species for use in genetic and taxonomic studies.[1])

Shumard oak, which commercially is a relatively unimportant species, was selected for this early report because of the outstanding nursery characteristics it displayed; no other species in the oak plantings exhibited such great differences in growth and fall leaf coloration.

Significant differences in height growth were found among seed origins in 1954 at the end of the first growing season. But in 1955, after the second growing season, the differences were not significant. This change is attributed to dieback that occurred in the late fall and winter of 1954. A progressive increase in dieback was evident in origins from north to south, ranging from none in Illinois seedlings to 28 centimeters in those from Florida (table 1).

The pattern of height growth exhibited by different lots of seedlings varied considerably during the first growing season. Measurements taken at three different periods in the season indicate that seedlings of northern origin grew more rapidly during the early part of the year; and by late in July they had nearly completed their annual height

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[1] Schramm, J. R., and Schreiner, Ernst J. The Michaux Quercetum. Univ. Pa. Morris Arboretum Bul. 5: 54-57, illus. 1954.

Table 1.--Data on seedlot origins and on seedling development by origins

Item	Origin (County and State)			
	Richland Co. Ill.	Knox Co. Tenn.	Tallahatchie Co., Miss.	Alachua Co. Fla.
Latitude ..... Degrees ..	38	36	33	30
Seedlot number	420	215	284	332
1954 progeny ..... No. seedlings ..	70	41	41	231
°Germination period ..... Days ..	8.0	7.0	6.8	8.8
°Height growth, 1954 ..... Centimeters ..	25.3	28.7	45.1	48.8
°Height in November 1955 ..... Centimeters ..	42.6	49.5	57.3	39.1
°Dieback, 1954-55 ..... Centimeters ..	0.0	13.7	15.1	28.0
°°First-year growth ..... Percent of year's as of May 28-June 3 total growth ..	54	48	25	22
°First-year growth ..... Percent of year's as of July 8-16 total growth ..	93	84	46	40
°First-year growth ..... Percent of year's as of Aug. 16-27 total growth ..	98	97	72	75

°Differences not significant at either the 1- or 5-percent level.

°Differences significant at the 5-percent level.

°°Differences significant at the 1-percent level.

Table 2.--Autumn leaf coloration in four lots of Shumard oak seedlings, November 10-14 of their second year

County and State	Grades of foliage coloration		
	All green	Intermediate[1/]	All red, brown, or dropped leaves
	Percent	Percent	Percent
Richland Co. Ill.	1	28	71
Knox Co. Tenn.	7	66	27
Tallahatchie Co., Miss.	10	78	12
Alachua Co. Fla.	77	15	8

[1/] Trees that have leaves colored green in combination with other colors.

growth (table 1). This is in contrast to the southern seedlings, which grew slowly during the early part of the season but continued growth into the fall.

The lots of seedlings differed significantly from one another in total height growth, in amount of dieback, and in growth rate measured at three different time intervals during the 1954 growing season. The genetic variation within the species was further demonstrated by extreme variability in autumn leaf coloration (table 2).

The differences in autumn leaf coloration between origins are highly significant by Chi-square test. The delayed coloring in the trees of southern origins is in accord with their longer period of growth. That is, both the percentage of trees continuing growth late in the season, and the percentage still holding green leaves and presumably

continuing photosynthesis in November, increased from northern to southern origins.

The prolonged activity of foliage in southern trees was associated also with prolonged succulence of stems, which in turn resulted in an increasing amount of frost damage from northern to southern origins.

Because of the marked variations in juvenile growth and frost hardness, knowledge of seed origin seems essential for the efficient use of Shumard oak in tree breeding and planting programs.

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Mr. Gabriel, who is now at the Experiment Station's laboratory at Burlington, Vt., was stationed at the Morris Arboretum at the time of this study. He adds a note of thanks to the many individuals who have made seed collections for the Michaux Querceutm, and to those who gave advice and made measurements in this study.